Unified Command Proposed Emergency Assessments and Abatement Measures
Subbase Road Oil Spill Site
St Thomas, VI
April 7, 2018

Objectives

The objectives of the emergency measures are to abate the discharge of petroleum product (product/oil) to Krum Bay (Bay) at the Subbase Road Oil Site (Site), and temporarily mitigate vapor build up in a utility vault at Ground Zero (GZ), located near the PUMA fuel terminal on Subbase Road (Figure 1). The GZ-vault is approximately 6 by 8 by 7 feet deep and provides a service/maintenance access to the Water and Power Authority (WAPA) main, high voltage (34KV) powerline for the islands of St. Thomas and St. John.

This document reflects the Department of Planning and Natural Resources (DPNR) and Environmental Protection Agency's (EPA) approach to implement the proposed emergency assessments and abatement measures as the environmental regulators in a Unified Command. The Unified Command consists of DPNR as the Territorial Lead over these emergency assessments and abatement measures, with EPA as the Federal Lead, in addition to other federal and territorial agencies, acting in a support role to DPNR. Response actions outlined below may be subject to change based upon site conditions and approval of the Unified Command.

Dynamic Conceptual Site Model (CSM)

Developing a CSM is an iterative process that is subject to change as more information becomes available.

A body of mixed products is likely present in the shallow water table zone at the Subbase Road Oil site (Site) due to historical and recent releases to the subsurface. The oil body breaks through at the Bay but the source is located both topographically and hydraulically upgradient. The most recent of the releases at the Site likely occurred at the Puma facility when gasoline leaked into the subsurface from Tank 57 (Figure 1). The recent release upgradient within the same oil body added and is adding to a historic release of oil to form an oil body mass that is driving the older releases further downgradient toward the Bay.

The subsurface oil is discharging to the Bay and recently volatilizing to three vaults: two on Subbase Road and the GZ-vault close to the Puma facility (Figure 1). The vapors in the GZ-vault periodically build up and recently exceeded their explosive limit resulting in two flash combustion explosions. Most of the oil discharges from the subsurface soils into the adjoining the Bay, with a lesser amount discharging from a storm water outlet that drains into the Bay. The oil discharging from the fill into the Bay is generally a light to locally heavy sheen. During dry periods, the amount of oil discharging into the Bay diminishes. However, during and subsequent to a rain event, the discharge of oil into the Bay spikes, with the biggest oil spikes associated with the largest the rain events. Additionally, fluid levels (oil and water) in the vault increase in response to the larger rain events. Discussion with several local residents and government employees suggested the largest oil spike was subsequent to the Irma/Maria hurricanes when the amount of rainfall was very large in comparison to what we observed. The local residents and government employees reported that the entire Bay was covered with oil. EPA personnel observed the increased oil discharge or spikes during following two rain events on March 25 and 27, 2018. It appears that increased recharge from rain events act as a water "flood" driving the oil body downgradient towards the Bay, resulting in an increased discharge or oil-spike into the Bay.

As the water table rises due to increased infiltration, fluid flow into the vaults increases, raising the fluid levels. The two vaults installed in Subbase Road also receive runoff from the road. Oil collecting in the GZ-vault appears to be gasoline. Oil collecting in the GZ-vault will volatize, producing vapors at the oil-water interface that are at the vapor pressure limit (maximum air vapor concentration). The volatile organic compounds (VOCs) concentrations decrease with distance to the top of the vault where organic vapors escape to the atmosphere. As the fluid level increases in response to a rain event, the vapor saturated interface rises toward the surface resulting in elevated VOC concentration at the vault's access portal.

Proposed Emergency Measures

The Unified Command proposes a two-phase response to the oil spill: (1) emergency assessment/abatement measures to abate oil discharging into the Bay and prevent vapor buildup in the GZ-vault, collect representative oil samples from the subsurface for analysis, and monitor vapor buildup in the vault over an extended period; (2) complete an oil spill investigation to delineate the extent of the oil body, oil variability (i.e., single or mixed hydrocarbons), interaction of various oil types in the subsurface, and site hydrogeology. All collected data will be integrated into a CSM to demonstrate the interaction between the oil and site hydrogeology.

The CSM will ultimately represent our current and updated understanding of site conditions, drive the investigative processes, and guide a long-term treatment strategy to address the oil body. This report addresses the approach to completing Phase 1.

Emergency Assessment/Abatement

Install up to six test pits along the road adjoining the Bay to determine the nature of the subsurface and the presence of oil migrating to the Bay (Figures 1 and 2). The test pits will be excavated to a depth of approximately 7 feet below grade and monitored for a period ranging from 24 to 48 hours. An oil-water interface probe will be used to periodically gauge the oil thickness over this monitoring period. Depending on the rate of oil accumulation in a test pit, oil recovery may be initiated with a portable peristaltic pump. Both oil and soil samples will be collected for analyses. The analytes will include Diesel Range Organics (DRO), Gasoline Range Organics (GRO), Oil Range Organics (ORO), Total Petroleum Hydrocarbons (TPH), Oil Fingerprint Analysis, viscosity, specific gravity and hazardous characteristics for disposal and any other analysis as required by the National Pollution Fund Center (NPFC). A schematic section through a typical test pit is displayed in Figure 2. Test pits that are not converted to an interceptor trench will be backfilled after monitoring is completed. The test pits will be covered and secured with steel plates as an overnight safety measure. General locations of the proposed test pits are shown in Figure 1, as locations may be moved based upon the geophysical survey and site conditions.

Test pits will be logged by a qualified geologist to determine soil types, presence of stratification, fluid levels, conceptualize the hydrostratigraphy, and trench stability during and after excavation. Of particular importance: are soil/sediment clast homogeneity, identification of fill and formation contacts, fill generations or formation stratification, layers of high (e.g., sand or gravel) or low permeability (silt or clay), depth to water, and hydrostratigraphic characterization (e.g., perched, unconfined, or confined). This information will have a significant impact on the design of the effectiveness of the interceptor trench. (Note: Test pits will need to be excavated in proposed areas for both the soil vapor extraction (SVE) system and the interceptor trench.)

In addition, soil samples should be collected for both TPH (GRO, DRO and ORO) analysis and physical characterization tests. Physical characterization tests will be performed on both the fill and formation material, and will include: grain size analysis, dry bulk density and percent moisture content. Most important are the grain size results because they are used to design an appropriate size or range of sizes for the trench backfill, which is termed the "effective" grain size. The effective size is site specific and needed to determine the appropriate slot size for the sump screens. The physical characterization of the fill and formation is also useful for designing the SVE system design.

The Unified Command intends to install the test pits and interceptor trench on the public access road; however, if access to private properties is required, the Unified Command will reach out to the property owners to obtain consent for access.

Ground Zero Assessment.

It is critical to obtain a sample of the oil in the GZ-vault, or at least an oil sample proximal to the vault. However, the energized, high-voltage powerline and logistics of timing required for a shutdown when oil is present in the vault, may preclude the Unified Command from obtaining a sample of the oil directly from the GZ-vault. If this is the case, an oil sample from the near vicinity of the GZ-vault can serve as a proxy. The Unified Command is currently investigating an approach for obtaining such a proxy oil sample. The details of this method have not been developed; however, before a method is implemented, an electrical health and safety expert will be consulted for their recommendations on the proposed sampling approach.

Oil Interceptor Trench Installation

Barring any surprises from the test pitting exercise, the Unified Command proposes to install approximately 150 feet of interceptor trench. The width of the trench will be defined by the width of the excavator/backhoe bucket. The purpose of the trench installation is to primarily intercept oil before it discharges to the Bay, and secondarily recover the captured oil.

Two conventional trench geometries are displayed in Figure 3. Installing the trench in shorter overlapping segments (Figure 3A) is preferable to installing one long trench (Figure 3B), because overlapping trench segments promote more efficient oil recovery. However, the limited road width, approximately 15 feet, may preclude the installation of trench segments. If three trench segments, with 10 feet of overlap are installed, approximately 190 feet of linear trench length will be installed in total (Figure 3A).

Schematics of a preliminary trench design are displayed in Figures 4, 5 and 6. The trench will be installed to a depth of 3 feet below the depth to groundwater at low tide (Figure 4). Eight-inch diameter sumps will be installed in the trench at approximately 30-foot intervals (Figure 5). Sumps will be fitted with portable oil skimmer pumps to recover oil accumulating above a pump specific threshold thickness. Recovered oil will be pumped to an aboveground storage tank at a secured location to be determined. The oil recovery volume is expected to be relatively small. A high-density polyethylene (HDPE) liner will be installed to a depth of approximately 4 feet from the bottom of the trench (Figure 4). The trench will be backfilled with gravel (or crushed rock) coarser than the surrounding fill to approximately 2 feet below the road surface. Readily available (durable, clean, washed, and graded) gravel shall be used to backfill the trench. Limestone gravel should be avoided, if possible. The oil will readily flow into the coarser gravel, but will not readily flow out due to capillary entrapment.

A geotextile membrane will be placed above the gravel, and suitable road base above the geotextile to approximately 6 inches below grade (Figures 4 and 5). The impacted portion of the road will be asphalted to grade and the sumps completed to grade with locking caps. All conveying conduits (tubes for oil, electrical wires, etc.) that connect the skimmer pumps will run below the road and will daylight off road upgradient of the Bay. The sumps will be completed with locking or secure enclosures, flush with the road surface.

Investigation/Trench Installation Derived Waste

Investigation and trench installation derived waste (contaminated soils) will be stockpiled on clean plastic. The Unified Command will work with other stake holders to ensure the safe disposal of the waste.

Emergency Abatement of Buildup of Ground Zero Vapor Levels

A SVE will be installed to abate the buildup of vapor levels in the GZ-vault. Figure 7 shows a schematic of the proposed system. In this scenario, extracted vapors will be released well above the breathing zone. This will eliminate the need to periodically close a section of Subbase Road due to unsafe vapor spikes. A vapor treatment system will be designed based on a VOC concentration of 500 ppm (the highest recorded concentration at the GZ-vault to date) and a vacuum pumping (extraction) rate of 50 cubic feet per minute (cfm). It is anticipated that extracted VOC concentrations will not exceed 500 ppm.

Geophysical Survey

Prior to any geophysical activities, a utility markout with oversight by the Unified Command will be completed. This will provide control areas for the geophysical survey to ensure the data quality is acceptable for the subsurface investigation. The markout locations will be tested first by the geophysical survey. Once the markout locations are verified with the geophysics, then the surveys can be performed in other areas where utilities are not expected to occur (to verify presence or absence).

A geophysical survey, should be able to provide more detailed information about the subsurface, such as layering and preferential pathways for migrating oil. A geophysicist will determine the appropriate geophysical method(s) to be used.

Estimated Schedule

It estimated that total installation of systems will take up to four weeks. Some tasks can be performed concurrently.

(1) Geophysics: 3 to 5 days
(2) Test pitting and monitoring: 3 to 5 days.
(3) Installation and instrumentation of trench: 10 to 15 days
(4) SVE system installation: 1 to 2 days
(5) Sampling product in GZ-vault or obtaining proxy sample: 1 to 2 days.

Miscellaneous

Prior to beginning the investigation of the Subbase Road Oil Spill site, the Unified Command requests the following assistance from the local authorities to:

(1) Remove/tow abandoned vehicles along road side to provided easy access to all areas important to the investigation.
(2) Support the investigative effort with the appropriate road closure measures.
(3) Assistance with traffic control, if deemed necessary.
(4) Perform a markout of all subsurface utilities to supplement the geophysical survey.
(5) Provide the parcel maps for the area of interest to identify the commercial property boundaries, right-of-ways, and utility trenches as a means to further ensure the safety of the workers performing the subsurface investigation.

Material Needs and Specifications

Trench Specification

Based on an interceptor length of 150 feet, width of 3 feet and depth of 7 feet, the following are the material estimates and specifications.

- Length: single trench will be 150 feet long (Figure 3B), or the segment trench network will consist of three overlapping sub-trenches totaling 190 feet of linear trench length (Figure 3A).
- Width: 20 to 36 inches (average = 24 inches)

- Excavation depth: 6 to 8 feet below grade; average = 7 feet (assumes the average depth to groundwater is 4 to 6 feet below grade)
- Excavation volume: ~ 3,990 cubic feet or 148 cubic yards (assuming three trench segments)
- Collections sumps: up to six vertically-placed, 8-inch diameter slotted pipes, spaced 30 feet apart
- Performance inspection: every 3 months

Refer to Figures 4, 5 and 6.

Assuming the trench required a horizontal to vertical slope of 0.5:1 to reach the required depth, the excavation would be:

- Dimensions: trench will be 10 feet wide at the surface and slope down to 3 feet wide at the bottom.
- Excavation depth: 7 feet (average)
- Excavation volume: ~ 320 cubic yards (assuming three trench segments or 190 linear feet)
- Collection sumps: same.

<u>Sump Specifications</u>

- 8-inch Schedule 40 PVC pipe (length varies)
- Bottom slip-on PVC cap
- Slot width: 50 (0.05-inch)

(Note: Based on a sump diameter of 8 inches, the minimum trench width is 20 inches, which allows for 6 inches on either side of the sump)

<u>Down-gradient Impermeable Liner</u>

Use a HDPE liner, 40-mil or greater. The liner should only be installed along the downgradient wall of the trench and should not cover the entire wall. For instance, if the trench is 6 feet deep the HDPE liner should extend no more than 4.5 to 5 feet down the trench wall (approximately 75 to 85% coverage). Approximately 1-foot of the liner should overlap the ground surface and be securely anchored in place (using large metal staples or other acceptable fasteners) prior to backfilling the trench.

Estimated quantity of HDPE liner is 1,100 square feet or 111 square yards.

<u>Trench/Excavation Backfill Material</u>

Backfill will consist of ¼-inch aggregate rock placed to within 2 feet of grade. The estimated volume of backfill needed for a rectangular excavation is 110 cubic yard and for a sloped excavation, 205 cubic yards, assuming 190 linear feet of trench. The local material type needed in order of preference would be:

1. Quartz sand, very coarse (effective size will need to be determined).
2. Crushed/pulverized rock: Volcanic or other igneous type rock. Average size should be less than or equal to ¼-inch. Note: Limestones and crushed coral products are NOT recommended.

Filter Fabric

Woven filter fabric should be placed over the top of the trench backfill material. It is used to separate the trench backfill from an overlying surface seal or road base (soil/fill material).

Heavy-Duty, Flush-Mount, Square Manholes (w/water-tight covers)

- Approximate size: 12 inch x 12 inch x 10 inch
- Total number: ~ 6
- Note: Manholes should be anchored in place using a high-quality concrete mix.

Recommended Oil Recovery Equipment

- Spill Buddy System™ (portable, non-dedicated unit)
- Quantity: 1 to 3 depending on oil flow rate, trench length and configuration (previously acquired info and specs provided as separate attachments)
- Vendor*: Clean Earth Technology, Inc., Vermont; Tel: 802-425-3710; web: www.cleanearth.biz
  *Maximum efforts will be utilized to procure local resources when available
- Monitoring/recovery schedule: initially, every 3 months

FIGURES

<Authors Statement>: Brief map summary of elements, source info., unique coordinate information.

Map Creation Date: <DayMonthYear> xxMonthxxxx

Coordinate system: <UTM, State Plane, etc.>
Zone or FIPS: <18N or 2100>
Datum (or other reference): <NAD83, NAD27, etc.>
Units: Feet or Meter

0 200 400 Feet

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EP-W-09-031
W.A.# SERAS-345

Figure 1
Site Map
Subbase Road Oil Spill
ST. Thomas, US Virgin Island

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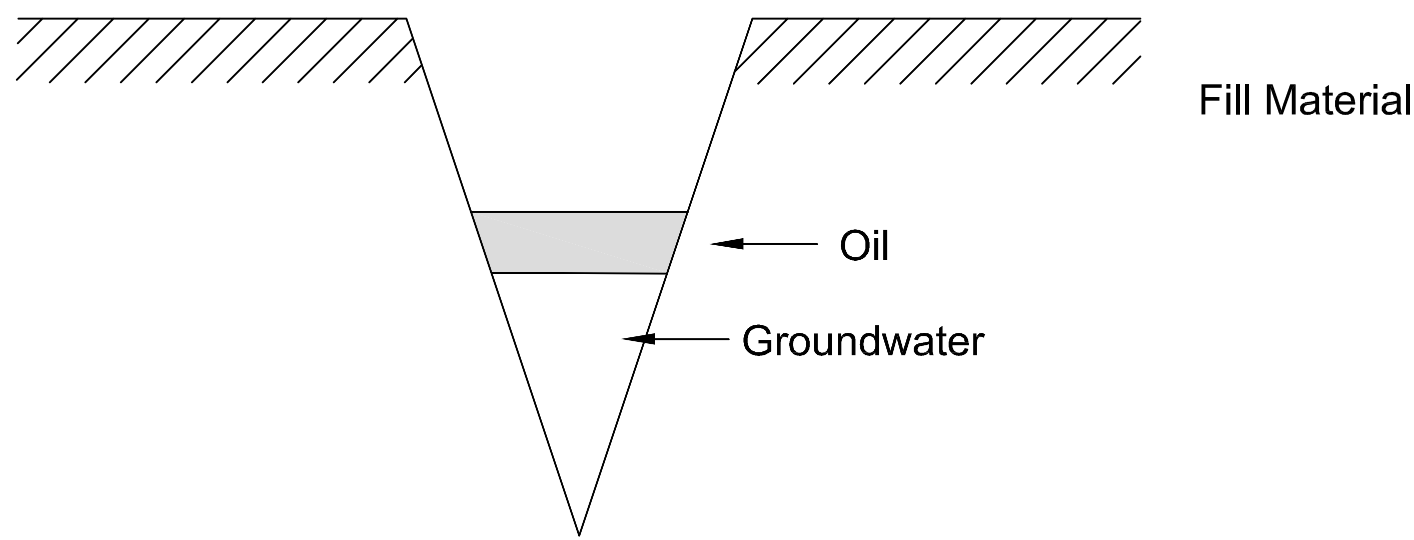
SECTION VIEW



Note: Conceptual Design; Not to Scale.

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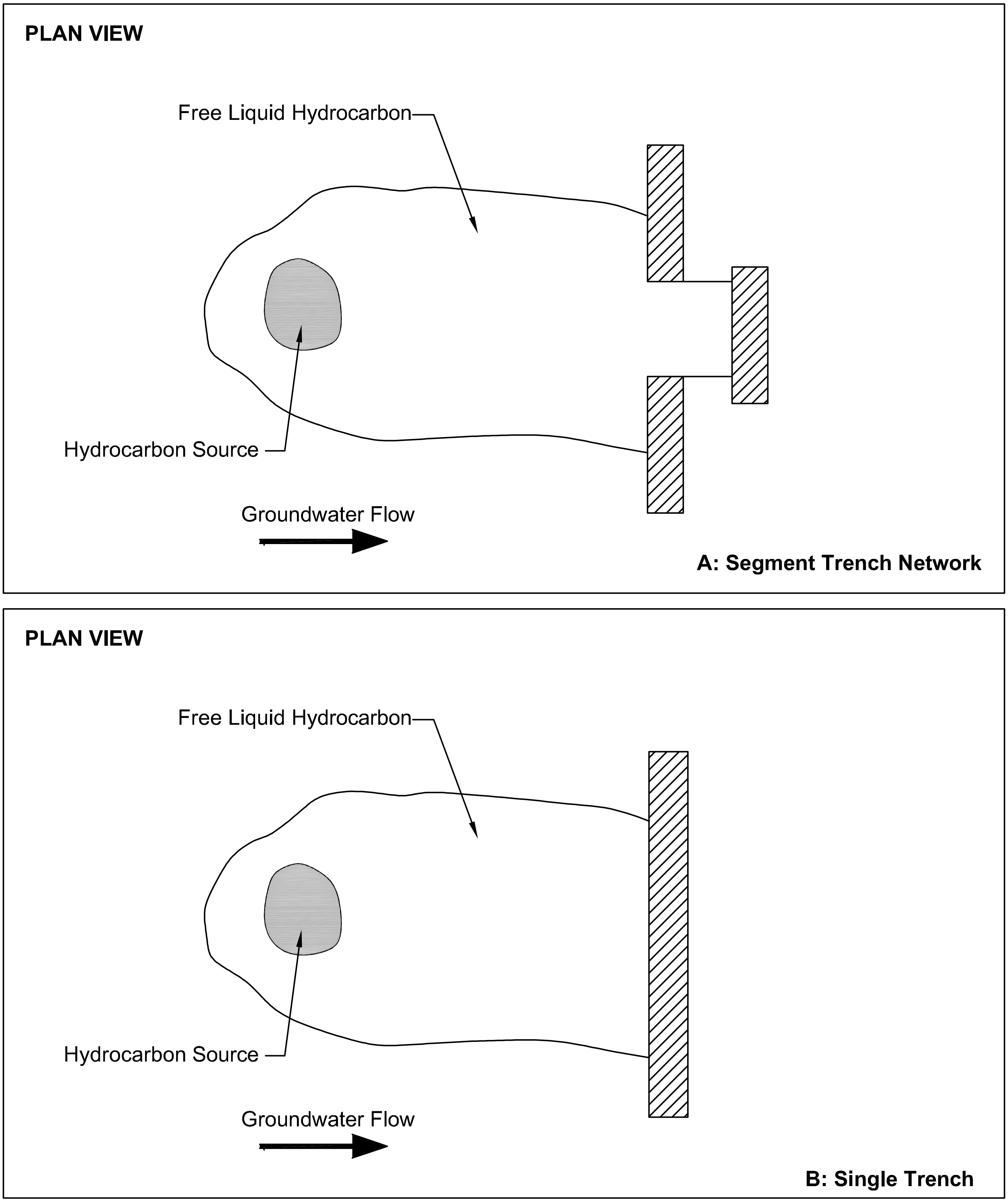
Figure 2
Schematic Test Pit Profile
Subbase Road Oil Spill
St. Thomas, USVI



Note: Conceptual Design; Not to Scale.

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Figure 3
Propose Trench Geometries
Subbase Road Oil Spill
St. Thomas, USVI

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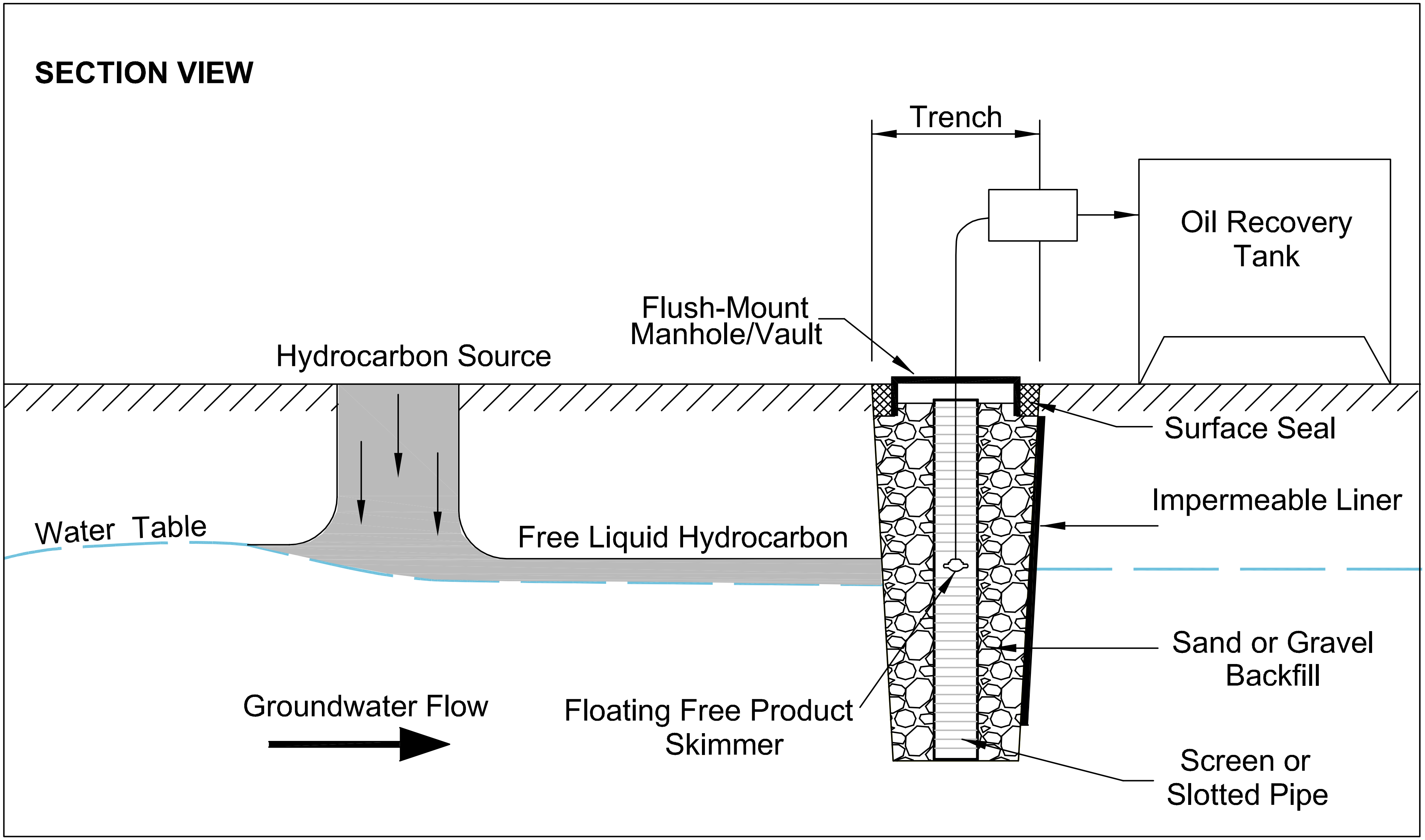

Note: Conceptual Design; Not to Scale.

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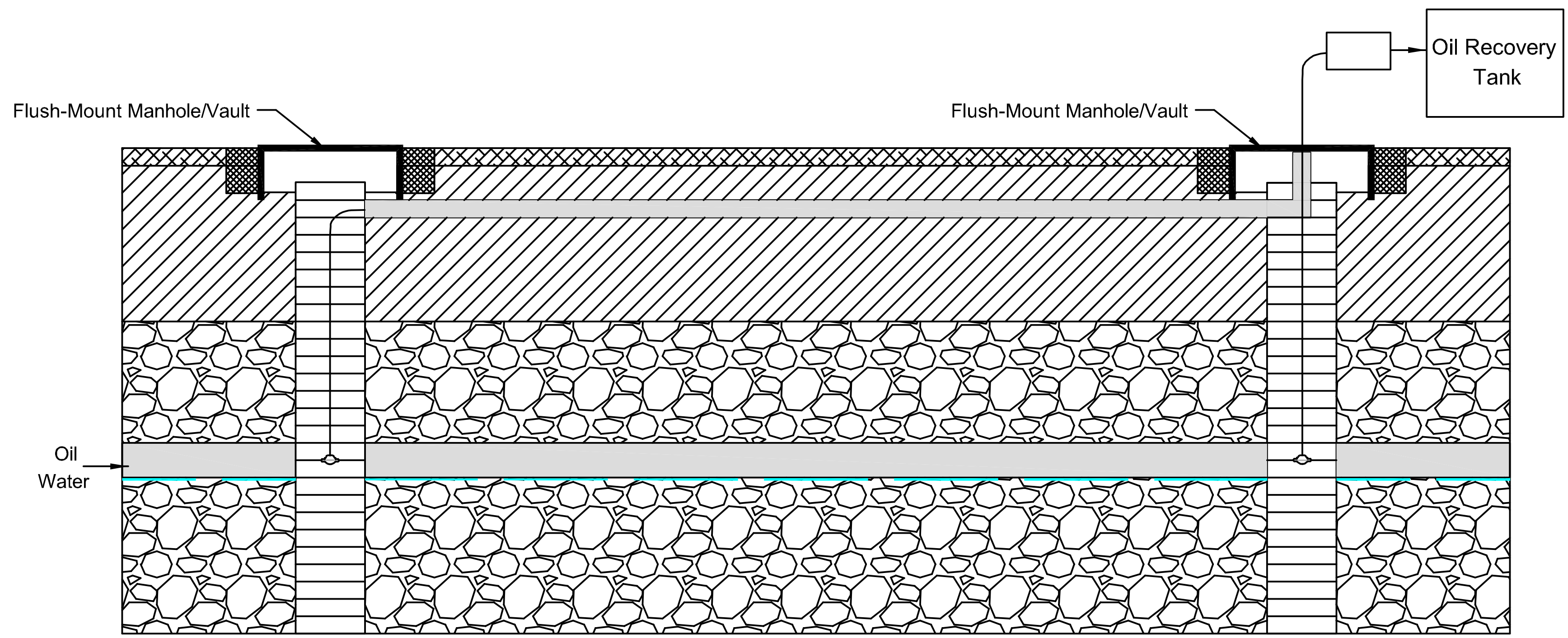
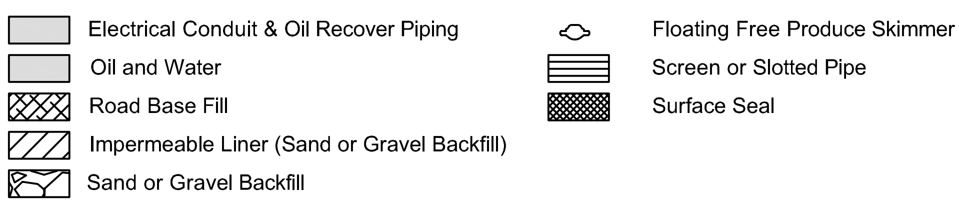
Figure 4
Schematic Interceptor Trench with
Skimming Equipment
Subbase Road Oil Spill
St. Thomas, USVI

SECTION VIEW



LEGEND



Note:
Impermeable Liner Installed Along The Downgradient Wall

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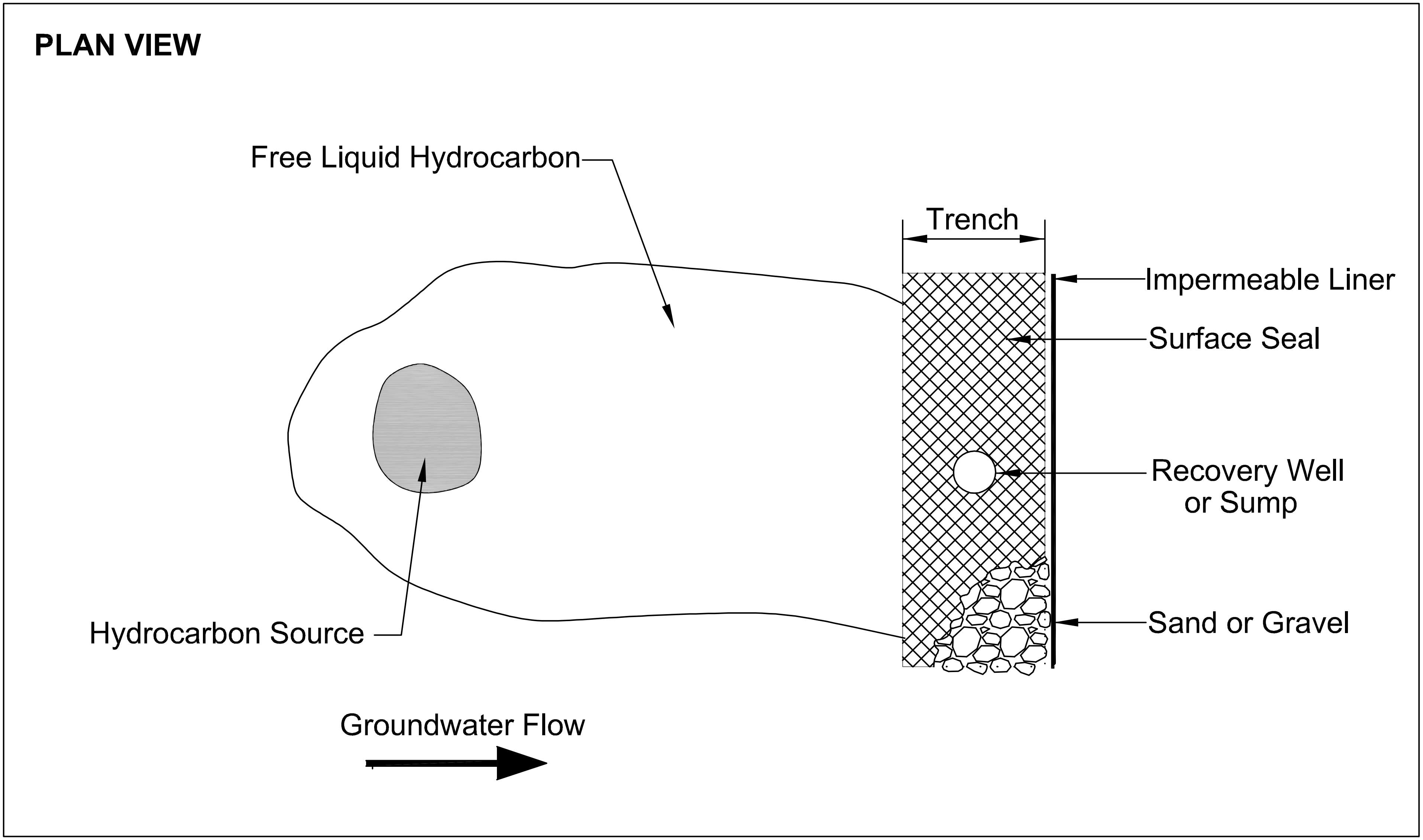
Figure 5
Interceptor Trench Profile with Skimming Equipment
Subbase Road Oil Spill
St. Thomas, USVI



Note: Conceptual Design; Not to Scale.

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Figure 6
Schematic Interceptor Trench
Subbase Road Oil Spill
St. Thomas, USVI

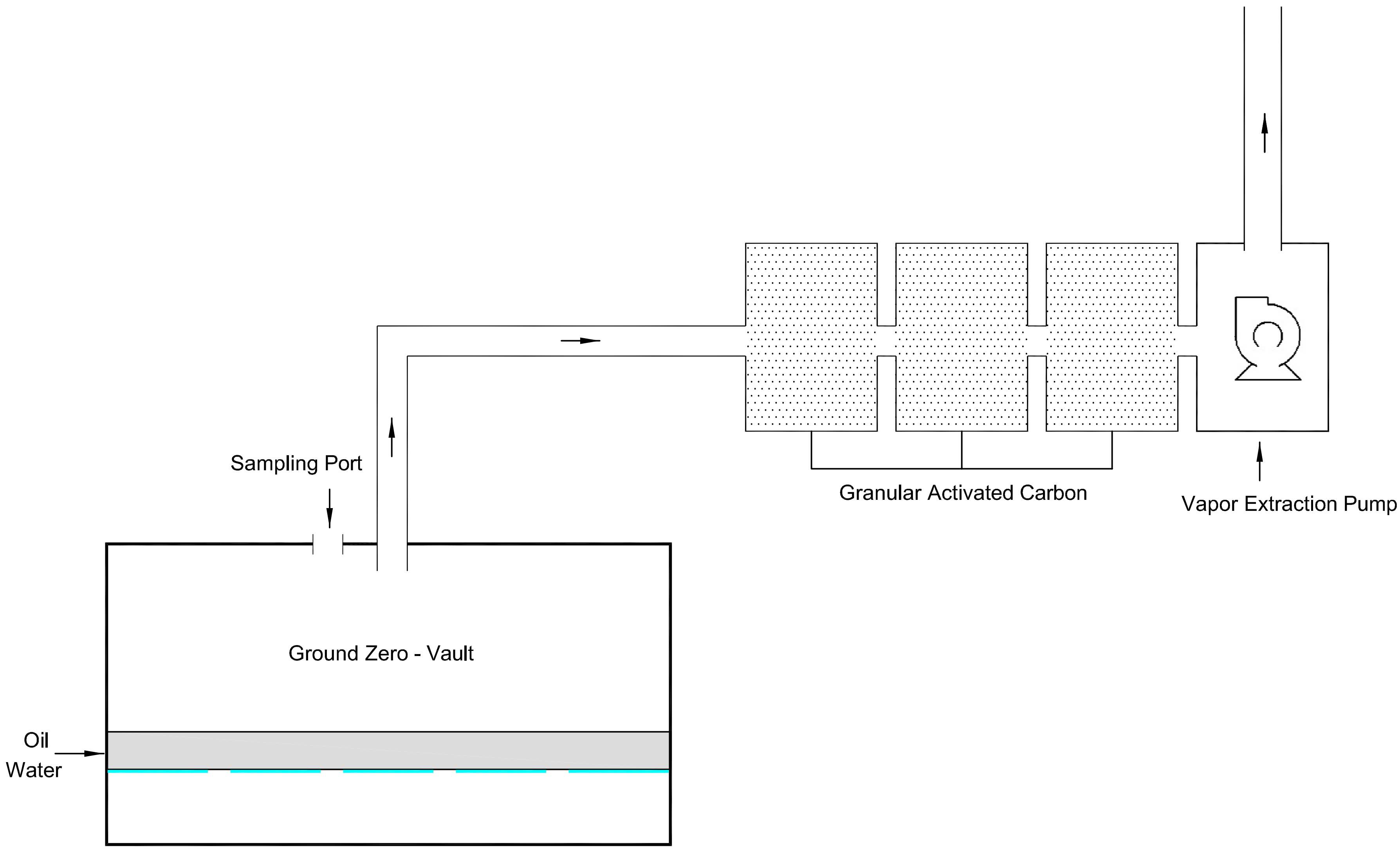

Figure7
Schematic & Vapor Extraction System
Subbase Road Oil Spill
St. Thomas, USVI

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